



CE Linux Forum

Japan Technical Jamboree #6

ARIB extension for DirectFB

Mitsubishi Electric Corp.

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■ Our Target

- Consumer Electronics, especially..
- AV appliances: Digital TV, STB, DVD, ..

■ Need for software platform

- Exponential growth of S/W volume in recent CE products
- H/W dependent system architecture limits development speed
- Need for CE software platform
 - like WINDOWS in the PC world, but not monopolized

■ Components required for the platform

- Operating System >> CE-Linux
- Window System >> DirectFB
- Media Handling >> DVB-API

selection criteria

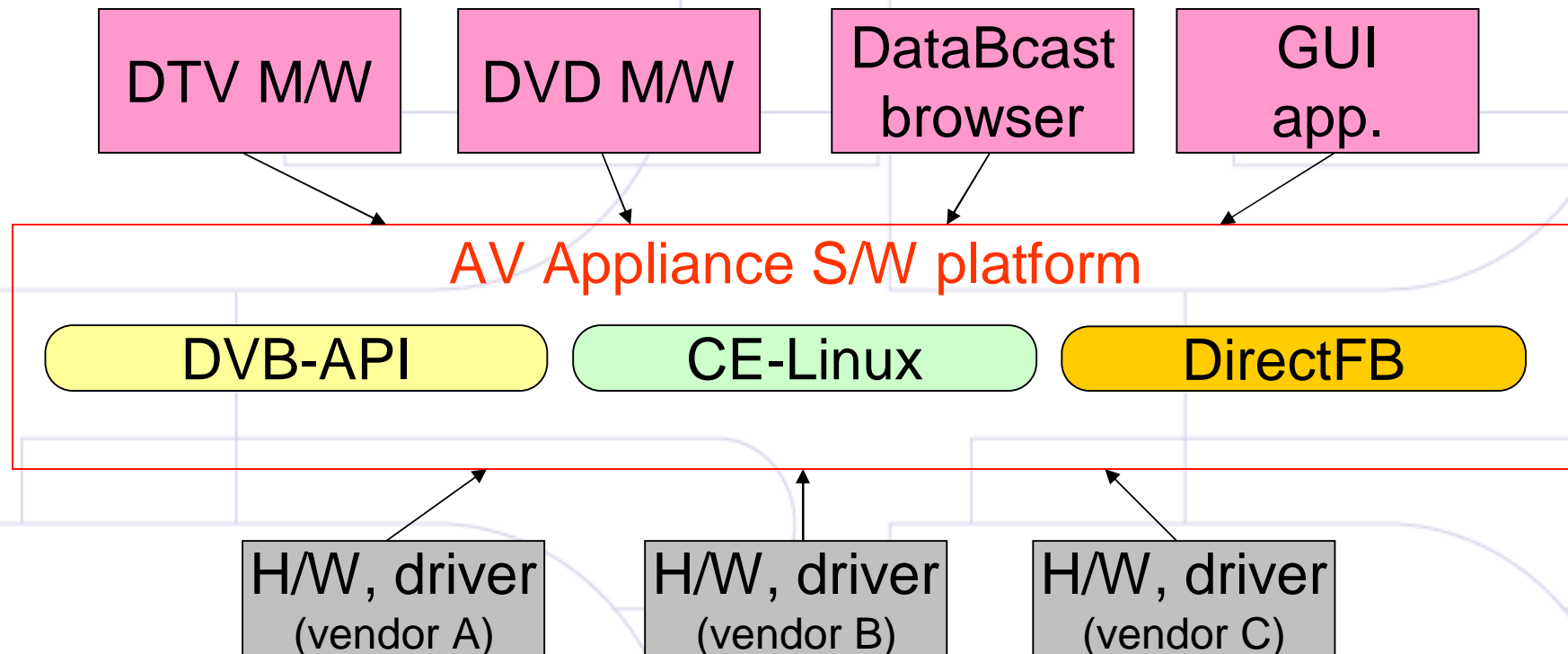
- Standardized
- Open Source
- Commercially usable
- Globally applicable

our initial selection



■ S/W platform we have in mind

- Hardware independent
- Application, middleware can be provided by third party



CELF AVGWG status



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Audio Video Graphics Working Group Session

San Jose face2face

Ruud Derwig, WG chair

11 Oct, 2005

CE Linux Forum Technical Conference

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Mitsubishi input: requirements

Because Mitsubishi's main interest is DTV/DVD area, we'd like to have AVGWG recommended tools, at least, for:

- Window System (supporting ARIB/MHP)
- UI widgets
- Graphics Interface to JavaVM (AWT)
- DTV control
- ATV control
- Audio file/stream player (wav, aiff, midi, ...)
- Image file player (jpeg, png, ...)
- Video file/stream player (mpeg, mjpeg, ...)

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Mitsubishi input: solutions

My proposal doesn't cover 100% of the list above. But, as most basics, I recommend following APIs:

- Window System
 - ARIB extended DirectFB on a single /dev/fb
 - Color space extended for DirectFB : 4:4:4 Equal number of samples of Y, Cb and Cr.
 - Memory Representation extended for DirectFB: 32bit AYCbCr 8bit LUT with AYCbCr Palette.
- UI widgets
 - GTK+2 with alpha support
- DTV control
 - driver level I/F: DVB-API V4 (ARIB extended)
 - application level I/F: UNAPI?

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:AVGWG Spec V2

WG内レビュー中(～06/2)

06/4のAGでのapprovalを目標

Initial v2 discussion

- APIs/technologies to be covered

- UHAPI

- DFB

- (Tiny)X / DRI

- OpenGL(es) (es good enough)

- Gstreamer

- OpenMax (if we can get a preview, resolve licensing questions)

- Framebuffer extensions ?

- LinuxDVB ? (DVB-API V4)

11 Oct, 2005 ALSA ?

- V4L ?

実装を伴わない
DTV制御用APIの
定義のみ

DirectFBは広く支持
されている

DTV制御の1実装
の位置づけ

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CELF AVGWG status



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AVG Core Group登録メンバー (Spec V2審議会)

- Ruud Derwig - chair, Philips
- Atsushi Hori - Mitsubishi
- Koichi Hiramatsu - Mitsubishi
- Imre Deak - Nokia
- John Vugts - Philips
- Bas Engel - Philips
- Hisao Munakata - Renesas
- David Siorpaes - ST
- Narm Gadiraju - [DigitalTelevisionProfileWorkingGroup](#) chair, Intel
- Scott Preece - [MobilePhoneProfileWorkingGroup](#) chair, Motorola
- (Michael Hunold - Toshiba)
- (Neill Trevett - 3D labs)

カーネルだけでなくミドルウェア領域についても
日本からもっと参加しましょう！！

Digital Broadcasting



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Quoted from DiBEG Seminar in Thailand, Oct 2004

Applications of Digital Terrestrial Television Broadcasting

高画質

HDTV



- High quality image and sound services

データ放送

Data broadcasting



- Simple program searching and retrieval of information at any time

移動体受信性

Mobile



- Stable reception services

多チャンネル

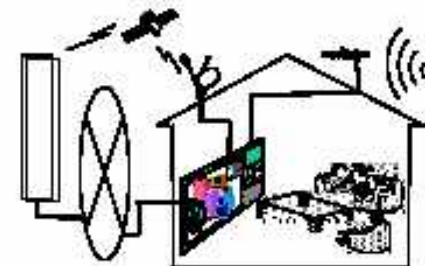
Multiple SDTV programs



- Realization of multiple channels

双方向性

Interactive TV

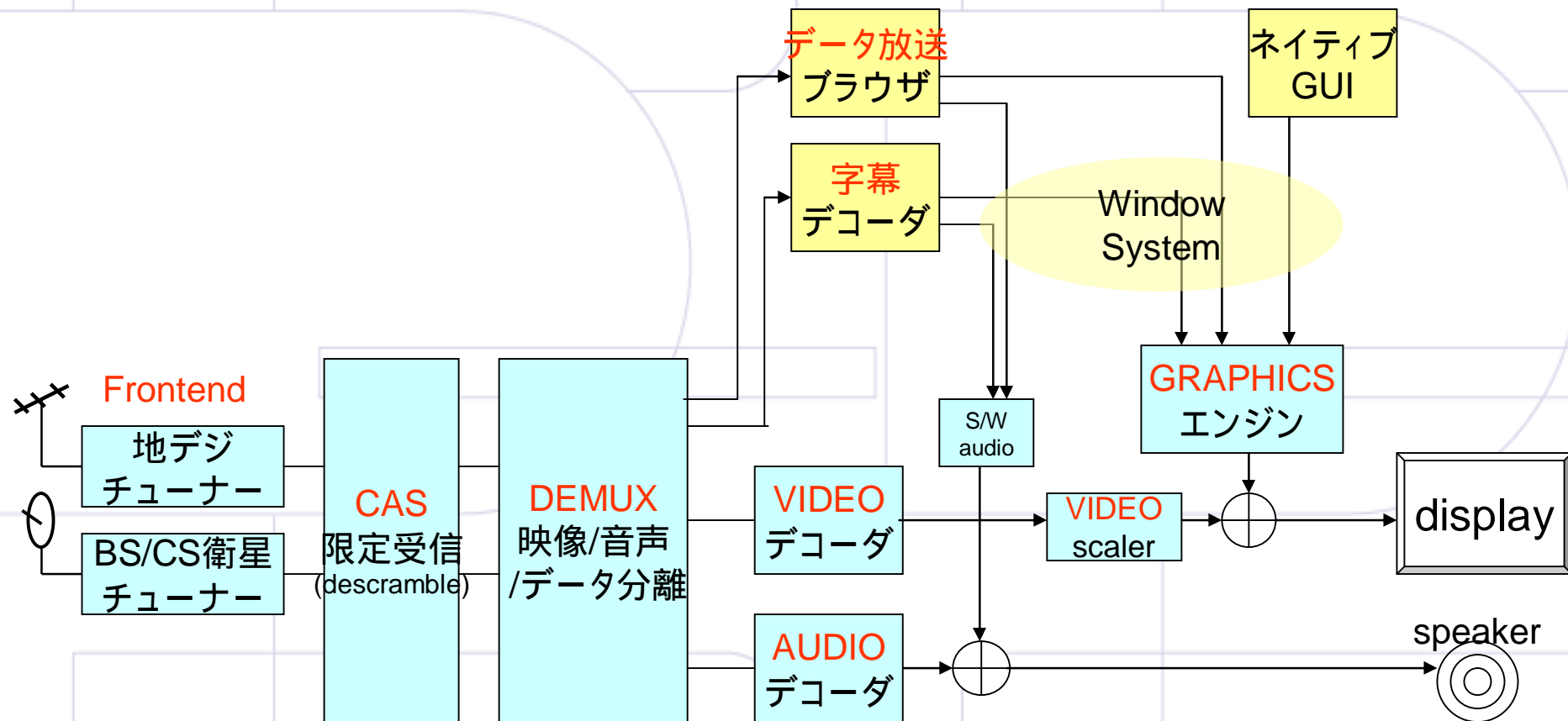


- Communication services and linked services

DTV Receiver structure



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CAS:Conditional Access System

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ARIB Extension



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- ARIB is the standard body for broadcasting in Japan
 - DTV related standards are based on MPEG / DVB, however,
 - In some aspects, there are differences not covered by DVB-API, DFB
 - ARIB Extension is one of important aspect to share globally applicable open source solution

ARIB: Association of Radio Industries and Businesses

	Europe	Japan	US
Standard body	DVB	ARIB	ATSC, CableLabs
Frontend	OFDM/QAM/xPSK	OFDM/QAM/xPSK	VSB/QAM/xPSK
CAS	DVB-CSA,SIM	B-CAS	POD/NRSS
Multiplexing	MPEG-2 System	MPEG-2 System	MPEG-2 System
Video Comp.	MPEG-2 Video	MPEG-2 Video	MPEG-2 Video
Video format	576i	1080i, 720p, 480i/p	1080i/p, 720p, 480i/p
Audio Comp.	MPEG-2 Audio BC	MPEG-2 AAC	AC-3
Data Bcast	DVB-MHP, MHEG	BML	MHP(OpenCable)
Caption	subtitle, teletext	ARIB caption, super	EIA 708/608

BML: Broadband Markup Language



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brief introduction of

ARIB extension for

DVB-API

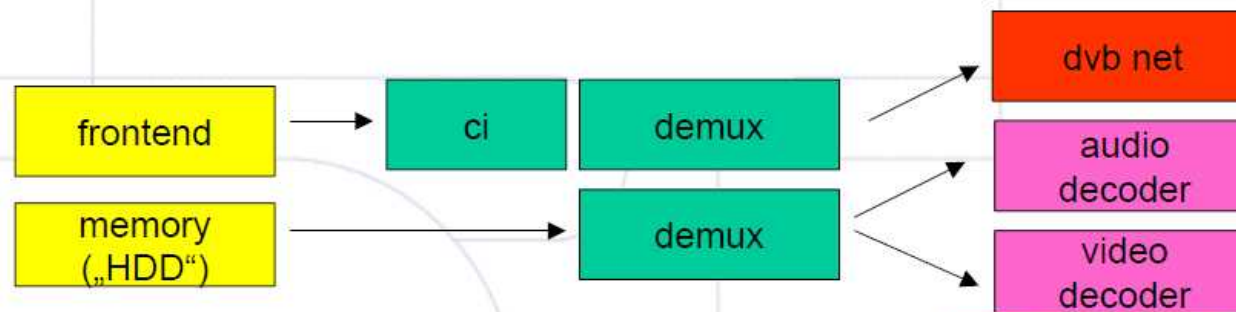


Quoted from Michael Hunold's Slide
(<http://tree.celinuxforum.org/pubwiki/moin.cgi/TechConference2005Docs>)



Linux DVB API v4 design

- Linux/Posix character device interface `/dev/dvb/adapter0/...`
 - input: frontend, memory
 - processing: ci, demux
 - decoding: video, audio
 - output: audio mixer, spdif, dvb-net
- source/sink connection via I/O controls
- zero copy DMA via `mmap()`



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TOSHIBA

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DVB-API V4



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Quoted from Michael Hunold's Slide

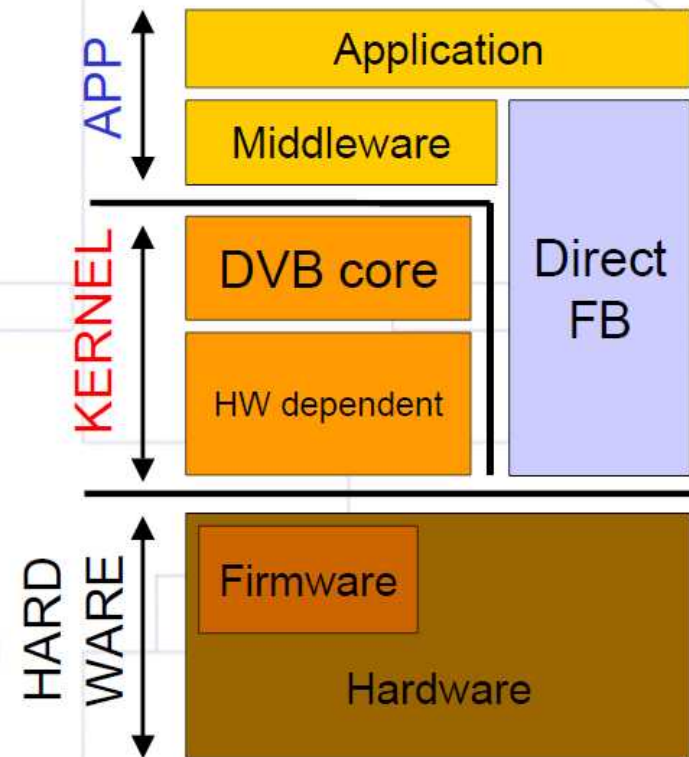
(<http://tree.celinuxforum.org/pubwiki/moin.cgi/TechConference2005Docs>)



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Implementation structure

- DVB core
 - implements hardware independent functionality
 - does sanity checks and parameter checking
 - enforces policy restrictions
 - different levels of abstraction
 - demux, frontend (high)
 - video (low)
- external APIs
 - graphics, scaler and video output handled by DirectFB



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■ Based on DVB-API Version 4

- API design is more in order than v3
- More suitable for embedded DTV hardware devices
- Somewhat early stage in its development

■ Mitsubishi proposal status

- implemented pre-alpha version of drivers for X86 PC
- source code is open at LinuxTV page (<http://www.linuxtv.org/>)



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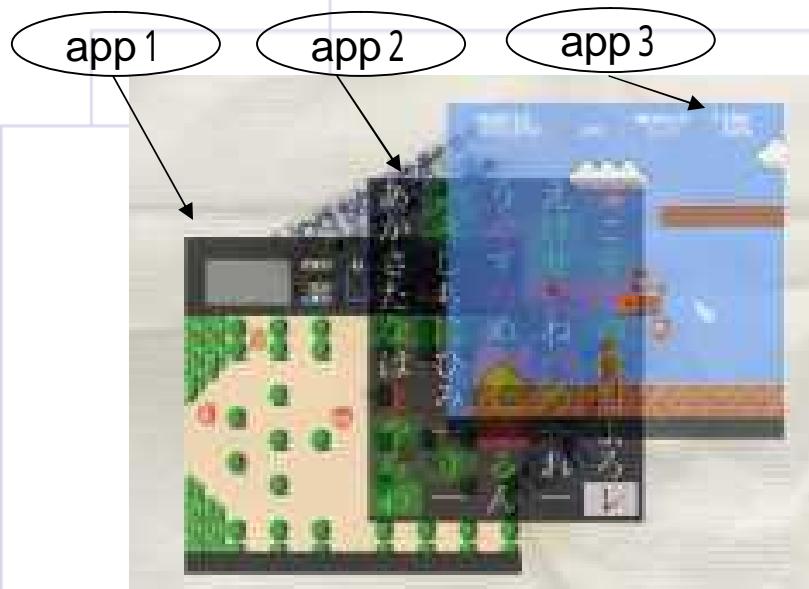
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ARIB extension for DirectFB



【DirectFB】

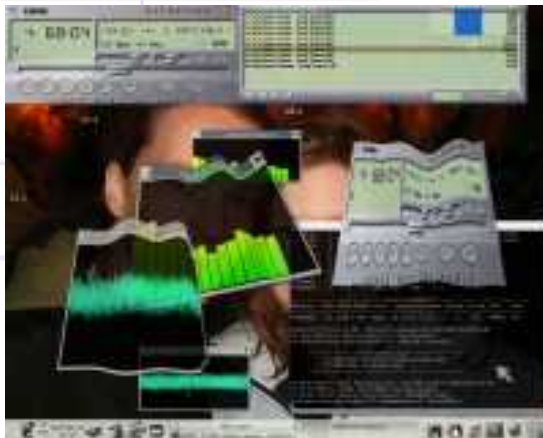
- 組み込み(CE)向け軽量ウィンドウシステム
 - DirectFB.orgでDenis Oliver Kropp氏(独)中心に開発(中)
 - “X” is dead. (開発スローガン)
 - LGPLライセンス
 - 欧州MHP対応を念頭に設計されている
- 特徴
 - グラフィックスH/Wと入力デバイスを抽象化
 - 半透過ウィンドウとマルチレイヤをサポート
 - LinuxのFrameBufferデバイス上で動作



Multi-application support



GTK+ on DirectFB



3D Window Management

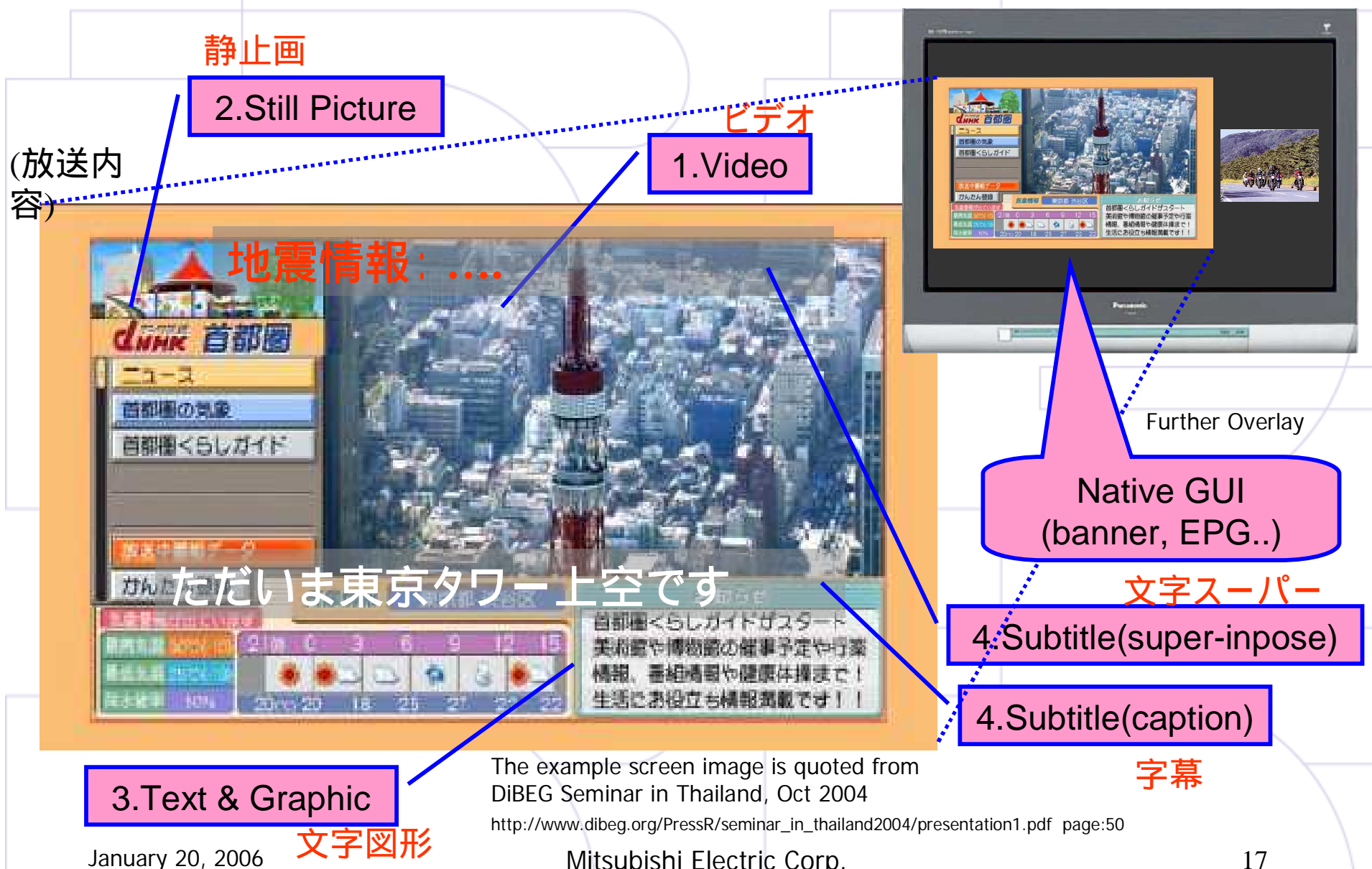
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ARIB presentation (example)



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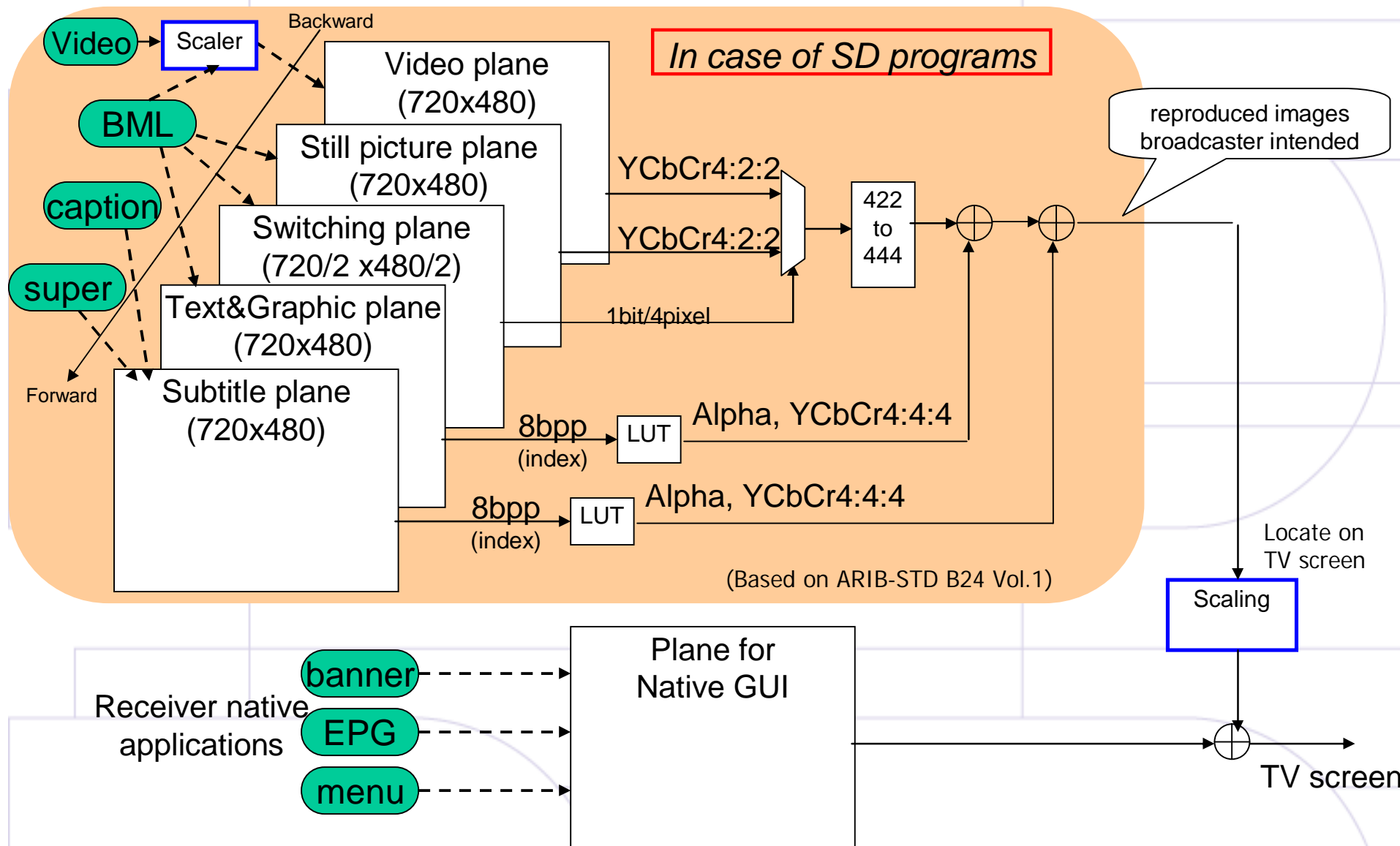


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ARIB presentation model



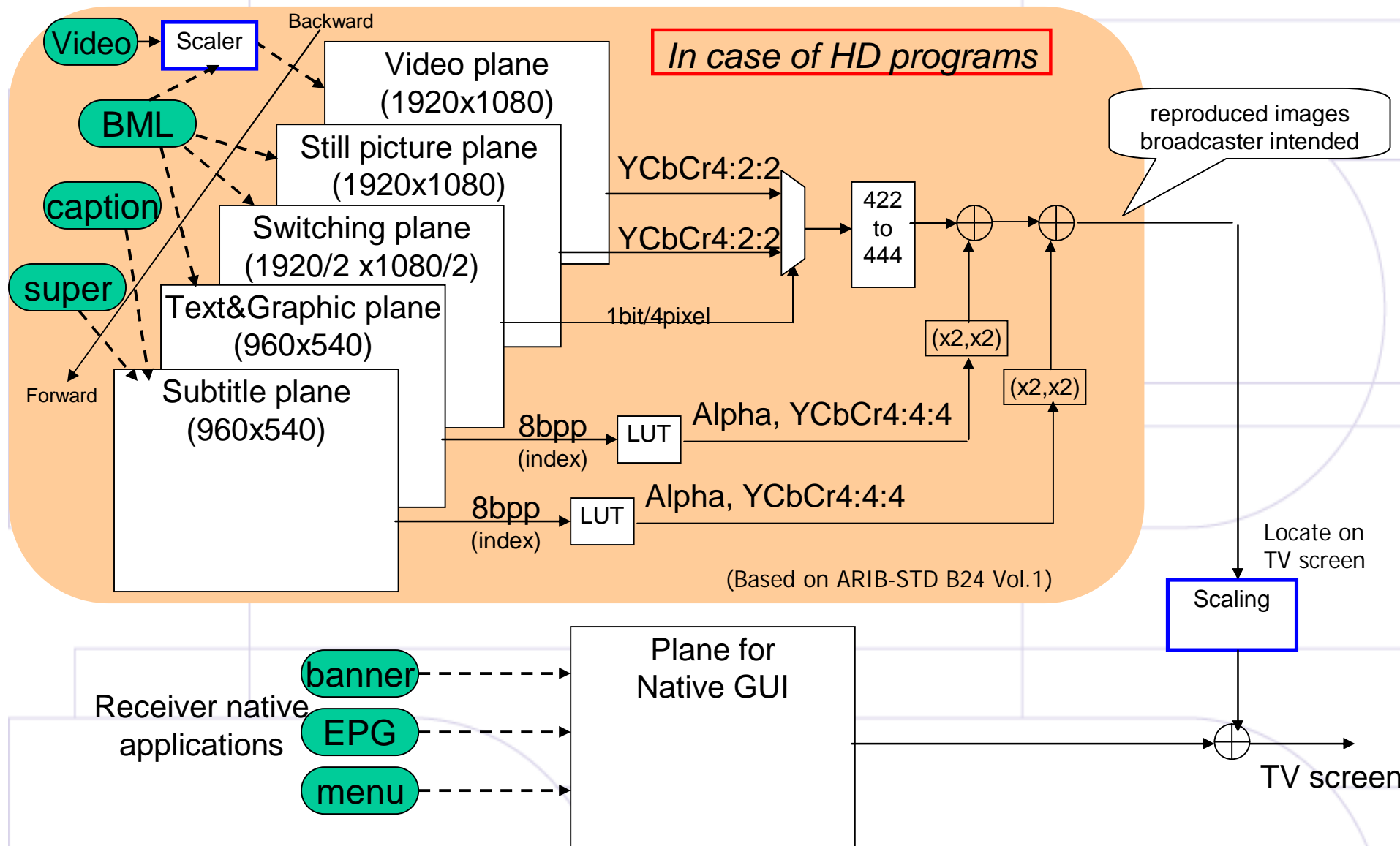
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ARIB presentation model



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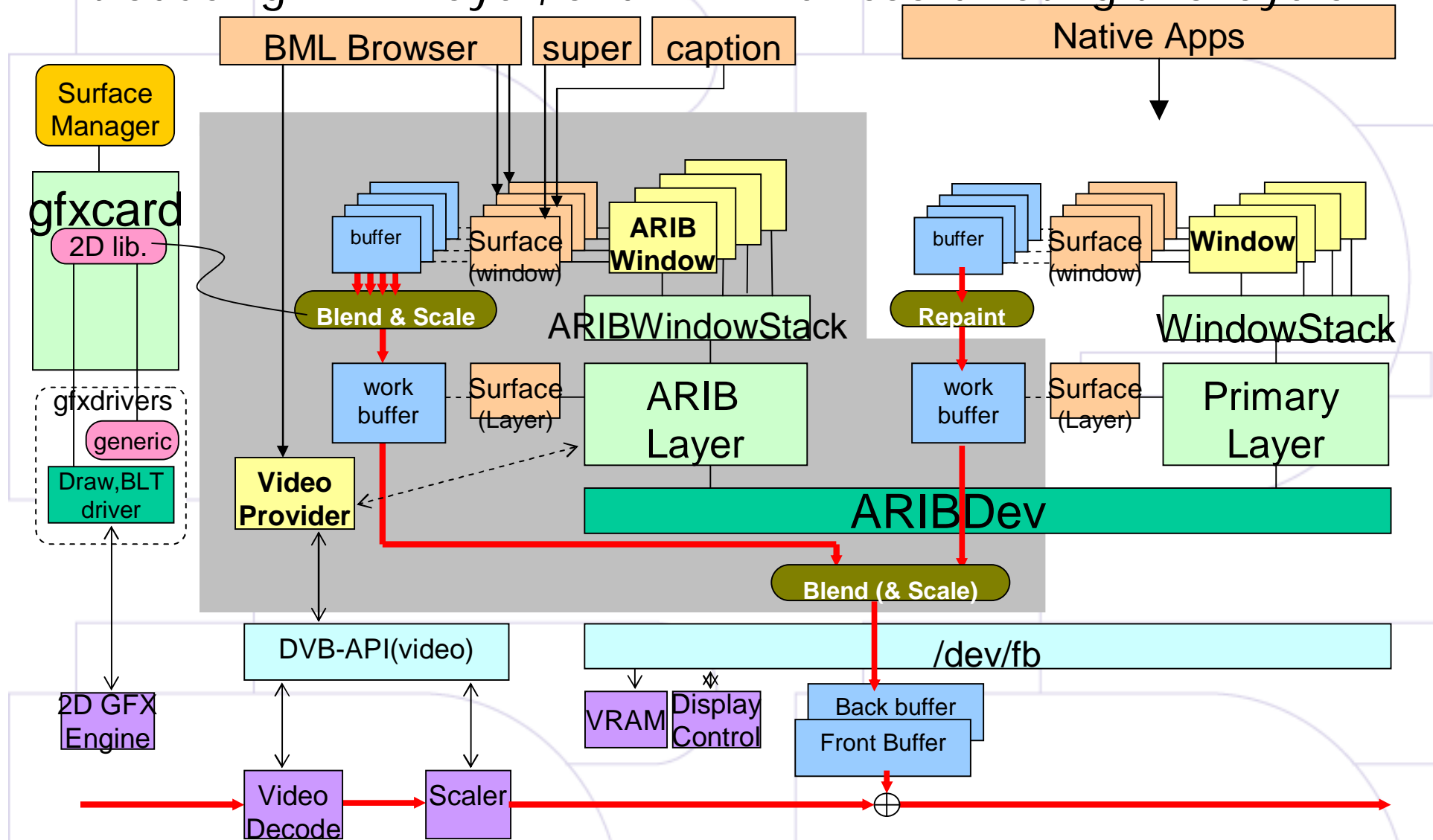


ARIB-extended structure



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- Introducing ARIB Layer, and ARIBDev coordinating two layers





■ Extension Policy

- Separate ARIB specific features as much as possible to avoid intervening in the trunk development
- Make as much use of the base DFB functionality as possible

■ Mitsubishi development status

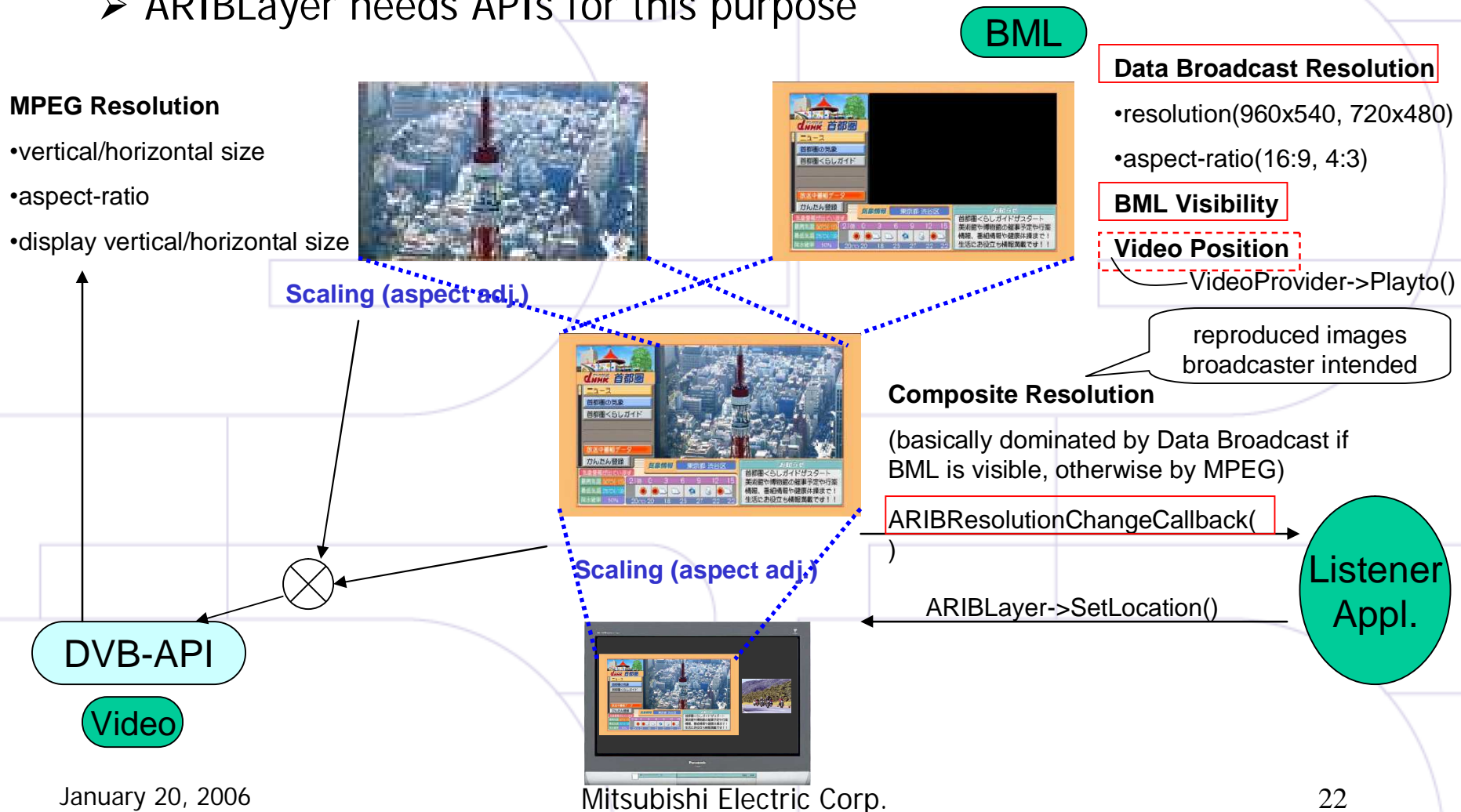
- Initial implementation: X86 CPU/VIA unichrome
- Porting to an embedded system is mostly done
- Currently based on DirectFB 0.9.21
- Planning to open source at directfb.org site (incremental)

本日デモ

Resolution & Aspect



- The ARIBLayer and VideoProvider should cooperatively handle resolution & aspect in accordance with ARIB rules.
 - ARIBLayer needs APIs for this purpose



Color space / Pixel Format



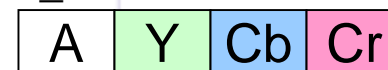
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- ARIBのコンテンツによる色指定は全てYCbCr形式
- RGBに変換すると、ビット数不足のため、淡い系統の色が色落ちしてしまう
- コンテンツの色指定をYCbCrのままH/Wデバイスまで伝えることを目的として、DirectFBのCore部実装をYCbCrを扱えるよう拡張する。

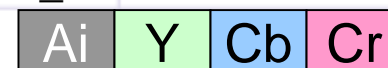
```
typedef enum {
    DSPF_UNKNOWN    = 0x00000000, /* unknown or unspecified format */
#ifdef DFB_ARIB /* 04.12.01 takahashi */
    /* 32 bit AYCbCr(4 byte, alpha 8@24, Y 8@16, Cb 8@8, Cr 8@0) */
    DSPF_AYCbCr     = DFB_SURFACE_PIXELFORMAT( 17, 24, 8, 1, 0, 4, 0, 0, 0, 0, 0 ),
    /* 32 bit AYCbCr(4 byte, inv. alpha 8@24, Y 8@16, Cb 8@8, Cr 8@0) */
    DSPF_AiYCbCr    = DFB_SURFACE_PIXELFORMAT( 18, 24, 8, 1, 0, 4, 0, 0, 0, 0, 1 ),
    /* 24 bit YCbCr (3 byte, Y 8@16, Cb 8@8, Cr 8@0) */
    DSPF_YCbCr24    = DFB_SURFACE_PIXELFORMAT( 19, 24, 0, 0, 0, 3, 0, 0, 0, 0, 0 ),
    /* 8 bit LUT AYCbCr (8 bit color and alpha lookup from AYCbCr palette) */
    DSPF_LUT8AYCbCr = DFB_SURFACE_PIXELFORMAT( 20, 8, 0, 1, 0, 1, 0, 0, 0, 1, 0 ),
#endif
} DFBSurfacePixelFormat;
```

```
typedef enum {
    DPCAPS_NONE      = 0x00000000 /* None of these. */
#ifdef DFB_ARIB /* 05.01.13 hiramatu */
    /* if this flag is set, the palette entries shall be interpreted as:
     * a -> Alpha, r -> Y, g -> Cb, b -> Cr */
    DPCAPS_YCBCR     = 0x00000001
#endif
} DFBPaletteCapabilities;
```

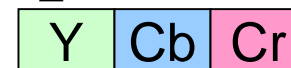
DSPF_AYCbCr



DSPF_AiYCbCr



DSPF_YCbCr24



(4 byte aligned at the end of line)



- ARIB規格のフォントは、FreeType2 のような一般的なフォントシステムとはいろいろな面で差異が多い。
 1. 4階調のグレースケールフォントであり、グリフを2bpp形式で表現される。
 2. フォントを描画する時の色は、4階調のそれぞれについて放送局が放送コンテンツの中で明示的に指定する。中間色を受信機側で勝手に補間割当てする訳にはいかない。
 3. ARIB規格の文字コードは(FreeType2で使う)Unicodeではなく、BMLではEUC-JP, ARIB字幕ではJIS0208。また、デジタル放送用の特殊文字が追加定義されているが、これらに対応するUnicodeコードポイントは従来確立されていない。
 4. DRCS (Dynamically Redefinable Character Sets). 放送局が放送コンテンツの一部として送り込む「外字」を扱わなければならない。
 5. 全て固定幅フォント。(プロポーショナルフォントはない)
 6. 描画先はLUT8(AYCbCr CLUT)色形式のsurfaceのみ。

DirectFBにはFreeType2をラスタライザとする“FontProvider”が標準装備されているが、上記のように差異が多いため、FreeType2を拡張するのではなく、ARIB専用の“ARIBFontProvider”を新規APIとして設けた。

